




Earthquake Basics

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Most earthquakes are caused by the sudden release of built-up stress along **faults**, fractures in the Earth's **crust** where large blocks of crustal rock move against one another. An earthquake's **size** can be measured by the amount of energy released by that movement. While scientists can't predict earthquakes, they are developing **earthquake early warning systems** that can provide seconds to minutes of warning when an earthquake occurs. Scientists can also estimate the likelihood of future quakes and use that information to design safer buildings and roads.

Why do earthquakes matter?

Earthquakes are a global hazard, taking millions of lives worldwide since 1900.^[1] In the United States, large earthquakes pose a substantial threat along the West Coast and in Alaska. A single event can be devastating: for example, the 1994 Northridge, CA, magnitude 6.7 earthquake caused at least \$40 billion in direct damage and killed around sixty people.^[1] While the West Coast has the most active faults, large earthquakes can also affect the Central and Eastern United States, as they did during the 1811 and 1812 [New Madrid earthquakes](#) and 1886 [Charleston, SC earthquake](#). Since 2009, a significant number of (mostly small) earthquakes have been observed in some areas of Oklahoma, Kansas, and other major oil- and gas-producing states; these earthquakes are mostly caused by the disposal of large volumes of [wastewater](#) in [underground injection wells](#).

How does geoscience help inform decisions about earthquake hazards?

Geoscientists measure earthquakes to pinpoint where they are occurring and determine the long-term earthquake hazard an area may face. This understanding of potential earthquake hazard is crucial for urban planning and earthquake-resistant design of buildings and infrastructure. Geoscientists are also developing earthquake early warning systems to give a few seconds to minutes of early warning once an earthquake has been detected.

References

¹The Significant Earthquake Database, NOAA National Geophysical Data Center, <https://www.ngdc.noaa.gov/nndc/struts/form?t=101650&s=1&d=1>

Learn More

Introductory Resources

- [The Science of Earthquakes](#) (Webpage), *U.S. Geological Survey*
A basic definition of earthquakes, what causes them, why they cause shaking, how they are recorded, how scientists can tell where an earthquake happened, and how scientists measure their size.
- [Seismicity of the Earth 1900-2013](#) (Website), *U.S. Geological Survey*
Historical maps of seismic activity for the entire Earth, with higher-resolution maps of more seismically active areas.
- [Recent Earthquake Teachable Moments](#) (Website), *Incorporated Research Institutions for Seismology (IRIS)*
Regularly updated website with downloadable slides and other teaching and learning materials for recent major earthquakes around the world.

Resources for Educators

- Education Resources Network, *AGI's Center for Geoscience & Society*
Search for earthquake resources in: [Professional Resources](#), [Organizations](#), [Curricula & Instruction](#), [Teaching Media](#), [Outreach Programs](#)
- NGSS Performance Expectations, *Next Generation Science Standards*
[3-ESS3-1](#), [4-ESS3-2](#), [MS-ESS3-2](#), [HS-ESS3-1](#), [2-ESS2-2](#), [4-ESS2-2](#), [MS-ESS2-3](#)
- NGSS [Disciplinary Core Ideas](#), *Next Generation Science Standards*
[ESS3.B](#), [ESS2.B](#)

Frequently Asked Questions

[Why and where do earthquakes happen?](#)

American Geosciences Institute

[Can earthquakes be predicted?](#)

U.S. Geological Survey

[What is the probability that an earthquake is a foreshock to a larger earthquake?](#)

U.S. Geological Survey

[Does hydraulic fracturing cause earthquakes?](#)

U.S. Geological Survey

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Maps & Visualizations



[Interactive map of California earthquake hazard zones](#)

California Geological Survey

The California Geological Survey's Earthquake Hazards Zone Application (EQ Zapp) is an interactive map that details the risk of earthquakes and related hazards for different areas of the state. The map is searchable by address, and it maps three main hazard zones: Fault zones Landslide zones...

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